Response to anonymous referee #3:

Reviewer's comment:

The article presents calculations of yield losses due to ozone in India – both in terms of biomass and monetary value. The work is quite comprehensive and combines available literature data with new damage functions obtained from open-top chambers for various crops. Based on the new functions, which indicate a relative high sensitivity to ozone, the calculated losses are higher by a factor of more than two than previously estimated.

Authors' response:

We thank anonymous reviewer for this compliment and the comprehensive review. In particular we would like to thank the reviewer for pointing us towards several more recent studies which we now include in the revised manuscript as detailed below.

Reviewer's comment:

A deficit of the paper is that it uses various cumulative indices to be related with the damage, which all are calculated from concentrations but not from uptake. This is not state of the art (Danielsson et al., 2013, Yamaguchi et al., 2014), despite AOT40 being still in use for such exercises (Feng et al., 2015).

Authors' response:

We appreciate the reviewer"s comment, that it is highly desirable to switch from an exposure based relationship to a stomatal flux based uptake-damage relationship which is based on crop models and mechanistic understanding. We have considered the possibility of including the stomatal flux based method for the present study, but found that it raised a number of serious issues and practical constraints when it comes to studying the exposure-yield relationships for South Asian cultivars. These are listed below:

1. The stomatal flux model DO3SE version 3.0.5 has been developed and validated mostly in European countries. In its current form the model can only handle a growing season that starts in spring and ends in summer/autumn and is unable to handle the growing season of the Indian wheat crop, which is sown between day 280-310 of one year and is harvested around day 90 of the following year. To overcome this limitation, one would have to use the measured hourly input data of ozone and meteorological parameters from the wheat growing season with fictional dates (shifted by 6 months with respect to the true dates). However, without good field observations that allow determining whether this brute force approach partially corrupts the model output, we are very hesitant to put such data into the peer reviewed literature. The developmental work required to adapt the model such that it can be used for the South Asian rabi season (wheat growing season) is beyond the scope of this paper and the model parameterization for South Asian cultivars cannot be undertaken without datasets suitable for model validation (see point 3 below).

2. Currently out of all the crops investigated in this study, only a parameterization for wheat is included in the model as pre-set and incorporated into the mapping manual. No parameterization for cotton, maize and rice is available as pre-set and studies adapting the stomatal flux model parameterization to other crops e.g. for rice are all recent (Yamaguchi et al., 2014). To our knowledge, no internationally agreed exposure yield relationship using flux based metrics exists for these crops.

3. Several recent studies have emphasised the need for a local parameterization of the stomatal flux model in particular for the Mediterranean climate, which in the European context comes closest to the climate under which wheat is grown in Northern India (Farez et al. 2012, González-Fernández 2013, Feng et al. 2015). However, the Mediterranean parameterization cannot be applied to the North West Indo Gangetic Plain, as the wheat crop in the Mediterranean is rain fed while wheat in

Punjab and Haryana is irrigated. González-Fernández 2013 found that in the Mediterranean ozone fluxes were limited by soil water content limitations to the stomatal flux (g_{sto}) when O_3 concentrations were above 40 nl l^{-1}. For irrigated crops this may not be the case and fluxes may be higher. Developing and validating a local parameterization would require a dataset of co-located high time resolution observations of ozone mixing ratios, meteorological parameters, plant phenology and time resolved measurements of stomatal conductance. For South Asia, no such comprehensive dataset is available in the literature.

4. A major point of our paper, as recognized by the reviewer, is to highlight the fact that South Asian cultivars are more sensitive to ozone than their European and American counterparts. To make this point, we needed to use data from studies conducted on both South Asian and the other types of cultivars. Till date, there is no single experimental study reporting flux-response data using the stomatal flux based uptake model for South Asian cultivars of any of the species considered. Hence, such a comparison is only possible on the basis of AOT40 and M7 exposure-response metrics. Studies reporting ozone exposure using these two metrics have been reported for a wide range of European, American and South Asian cultivars.

We would also like to point out that, most recent global and regional modelling studies still rely on the AOT40 metrics (see e.g. Texeira et al. 2011, Avnery et al. 2011a,b, Hollaway et al. 2012, Amin et al. 2013, Ghude et al. 2014, Feng et al. 2015, Chuwah et al. 2015) for several reasons which include that exposure response relationships relying on this metric are available for a large variety of crops, internationally recognized and that the application is simple and user friendly, requires no validation for different climates and can accommodate different cropping seasons/sowing dates .

Therefore it is clear that this is not a deficit specific to the present work. However the reviewer's general suggestion is appreciated and so we have revised the description of the leaf ozone uptake based exposure indices (P 2362 line 19 onward) to be more specific about the advantages of the stomatal flux modeling approach.

The full description, however, has been shifted from the Materials and Methods section to the Introduction in response to the comment about the confusing structure of our manuscript (see below).

Moreover, we have pointed out the need to move towards ozone uptake based models for crop yield loss assessments in the "Conclusion" as an area of future research for South Asian cultivars.

Modifications in the text:

P 2362 line 19 onward the revised text now reads:

"Recently stomatal flux-based critical levels were proposed to address concerns that the AOT_{40}-based critical levels are based on the concentration of ozone in the atmosphere whilst the ozone related damage depends on the amount of the pollutant reaching the sites of damage within the leaf (Emberson et al., 2000; Mills et al., 2011b). Models using stomatal uptake of O3 (flux; F) or its cumulative value, dose (D) have significantly improved the prediction of plant injury and have addressed the asynchronicity of maximum stomatal conductance (g_{sto}) and peak ozone in particular in plants that close their stomata when temperatures or the water vapour pressure deficit around the leaves are too high (Ainsworth et al., 2012, Fares et al. 2013, Feng et al. 2012, Danielsson et al., 2013, González-Fernández 2013, Yamaguchi et al., 2014). Stomatal flux of ozone is modelled using a multiplicative algorithm adapted from Emberson et al. (2000) that incorporates the effects of air temperature, vapour pressure deficit of the air surrounding the leaves, light, soil water potential, plant phenology and ozone concentration on the maximum stomatal conductance, i.e. the stomatal conductance under optimal conditions. The exposure yield relationships based on this algorithm consider the accumulated stomatal flux over a specified time interval as PODY (the Phytotoxic Ozone Dose over a threshold flux of Y nmolO$_3$, m^{-2}, PLA, s^{-1} with Y ranging from 0 to 9 nmolO$_3$, m^{-2}, PLA, s^{-1} (Mills et al., 2011b). Studies evaluating the PODY based exposure yield relationship for a wide range of climate zones have emphasised the need for a local parameterization of the stomatal flux model (Fares et al. 2013, Feng et al. 2012, Danielsson et al., 2013, González-Fernández 2013,

Yamaguchi et al., 2014) . To the best of our knowledge no parameterization for South Asian wheat and rice cultivars has been reported in the peer reviewed literature. The wheat parameterization has been developed using European cultivars (Mills et al., 2011b) and for rice the parameterization has been developed using only one Japanese rice cultivar, Koshihikari (Yamaguchi et al. 2014), which is know for its ozone resistance (Sawada and Kondo 2009) . Despite the fact that the stomatal flux based model is recommended by the UNECE CLRTAP (United Nations Economic Commission for Europe Convention on Long-range Transboundary Air Pollution) for ozone risk assessment in Europe based on accumulated stomatal ozone fluxes over a threshold (UNECE 2010), exposure yield relationships have so far been internationally agreed upon only for a limited number of crops (Mills et al., 2011b)."

We have inserted a paragraph on Page 2383 line 8 and have modified the text to: "For all crops screening a large number of domestic cultivars using the new stomatal flux based exposure metrics to identify and promote those cultivars that are less susceptible to ozone damage also offers a way forward."

Reviewer's comment:

The other concern I have about this paper is that it is rather confusing because it mixes a review paper with an analysis based on newly derived functions.

Authors' response:

The newly derived functions are derived based on a literature review of the available data. We have made this clearer in the revised introduction. Moreover, we have restructured the introduction, shifted some of the text from the "Materials and Methods" section to the introduction and used the subheadings "1.1 Ozone effects on plants", "1.2 Metrics to assess the impact of ozone on crop yields" and "1.3 Present study"

to improve the clarity of the manuscript.

Modifications in the text:

Page 2359 line 12 We inserted the sub heading "1.3 Present study"

With the following text:

"In the present study, we present new ozone exposure crop yield relationship for Indian rice, wheat and maize cultivars derived through a review of the peer reviewed literature of open top chamber studies on South Asian cultivars.

We verify these new relationships using ozone monitoring data from the Atmospheric Chemistry facility in Mohali and yield data from a number of relay seeding experiments conducted in Punjab and Haryana. In these experiments crops were coincidentally exposed to different ozone levels by virtue of shifting their sowing date, but the relevant studies were not conducted to investigate the effect of ozone on yields and consequently they did not include on-site ozone monitoring or clean air control treatments.

We subsequently use a high quality dataset of in-situ ozone measurements at a regionally representative suburban site called Mohali and the newly derived exposure –yield functions to assess ozone related crop yield losses for wheat, rice, cotton and maize for Punjab and the neighbouring state Haryana for the years 2011–2013. Crop yield loss estimates calculated using two different exposure metrics, AOT40 and M7, are inter-compared for a number of sowing dates and exposure-yield functions for the two major crop growing seasons of Kharif (June–October) and Rabi (November–April)."

Reviewer's comment:

Furthermore, it is very difficult to evaluate the methodology because concentrations, indices, and response functions are described at various places and only part of what is given in the descriptions is actually used.

Authors' response:

We thank the reviewer for this feedback. To improve the clarity of the manuscript, we have removed the historical overview and retained only equations for M7 and AOT40, the two metrics used for our analysis, in the materials and methods section. We have also removed the ozone exposure according to the M12 and W126 metrics from all tables.

We have shifted part of the historical perspective and description of the flux based method to the introduction and placed it under the heading "1.2 Metrics to assess the impact of ozone exposure on crop yields"

Reviewer's comment:

In addition, the importance of when the grain is sowed is often stressed but a sensitivity analyses about different sowing dates is not provided.

Authors' response:

Sensitivity analyses using 5 different sowing/harvesting dates for both rice and wheat, 3 different sowing/harvesting dates for cotton and 2 different sowing/harvesting dates for kharif and rabi maize, had already been presented in the study. These results were in supplementary tables 1-4 and were/are discussed in the text. Since the reviewer #3 missed out on the material in the supplement, we have shifted these tables back to the main manuscript to ensure this does not happen to other readers.

Modifications in the text:

Shifted supplementary table 1-4 to the main manuscript

More specific remarks:

Introduction

Reviewer's comment:

P2357 (L20ff): The explanation about possible increased ozone damages under drought stress neglects that drought stress reduces the stomata conductance and thus the ozone uptake and damage. I guess that the somewhat strange argumentation refers to the impact of ozone to stomata regulation (Paoletti & Grulke, 2010). Differences in sensitivity to this effect could indeed cause a different ozone responses but I cannot follow the argumentation that is should occur more often in South Asia than in other regions.

Authors' response:

The yield loss mechanisms of plant phenotypes which close their stomata under stress conditions were discussed on Page 2358 (Line 13ff). We thank the anonymous referee #3 for pointing out that we did not mention that drought stress reduces ozone uptake in such plant phenotypes and have included this point.

On Page 2357 (Line 20ff) we discuss only plant phenotypes for which ozone stress interferes with stomata regulation, though we did not refer to the work of Paoletti & Grulke, (2010) on stomatal sluggishness but to the work of Mills et al. (2009) and Wilkinson & Davies (2009, 2010), referenced through a review (Wilkinson et al. 2012) which reported that for certain plant phenotypes, stomatal sensitivity to abscisic acid is compromised in O_3-stressed plants which can result in additional drought stress (the plant hormone abscisic acid normally controls stomata closure and reduces water loss under drought conditions). We did not intend to suggest that this mechanism impacts only South Asian cultivars. We meant to suggest that losses because of such a response would be disproportionally large in South Asia for two reasons. Firstly, temperatures under drought conditions are at the upper end of the species tolerance range (often exceed 40ºC) and mid-season drought is a frequent phenomenon during monsoon season. Secondly, South Asia has a large number of rain fed landholdings with no access to irrigation.

Modifications in the text:

On Page 2357 Line 24 "Consequently, such plant phenotypes when exposed to both drought and O_3 will continue to lose water despite the potential for dehydration. Ozone related crop yield losses in such phenotypes may be enhanced in rain fed regions where kharif cops are frequently exposed to mid- season drought during monsoon season. On the other hand, the yield of rice cultivars that show a healthy response to drought stress (i.e. close their stomata aperture rather than having a sluggish response) could substantially benefit from the system of rice intensification (SRI) cultivation practise (Turmel et al. 2011) in areas with high ozone mixing ratios. Paddy fields under SRI cultivation are irrigated only when rice plots dry too much and the crop starts withering. A healthy response of rice plants to soil drying would reduce the ozone uptake and could explain the higher yields frequently observed for SRI plots during field trials as well as the spatial variability of the yield difference between SRI plots and control treatments.

Reviewer's comment:

P2358: The overview about ozone damages seems more or less comprehensive but more recent reviews are available as references (Ainsworth et al., 2012, Kangasjärvi & Kangasjärvi, 2014, Leisner & Ainsworth, 2012). Particularly the role of induced defences, which could be the cause of yield declines without visible injuries could be mentioned (Heath, 2008, Iriti & Faoro, 2009). Turmel

Authors' response: We thank reviewer #1 for pointing us towards these interesting reviews and have revised the overview about the ozone damages to include these more recent studies as detailed below.

Modifications in the text:

Page2357 L16 Pleijel et al. 1991, Heath 2008, Iriti and Faoro 2009

Page 2357 L19 Wilkinson et al. 2012, Ainsworth et al. 2012, Leisner and Ainsworth 2012

Page 2358 L4 Heat 2008, Iriti and Faoro 2009, Kangasjärvi and Kangasjärvi 2014

Page 2358 L14Torsethaugen et al., 1999, Heat 2008, Iriti and Faoro 2009, Ainsworth et al., 2012,

Page 2358 L19 "Plants of this phenotype may show little to no visible leaf damage, and often allocate significant resources to induced defences following ROS…"

Reviewer's comment:

Materials and Methods

Here, five metrics and a historical overview about ozone damage related indices is presented although only two indices are used for further analysis. Moreover, the flux based calculation may be complemented by more recent formulations (Danielsson et al., 2013). Overall, this seems to be unnecessary comprehensive.

Authors' response: We have removed the historical overview and now discuss only M7 and AOT40 in Materials and methods section, as pointed out earlier in this response.

Modifications in the text:

Shifted P2361 lines 2-15 to the introduction. Replaced this text with

"We use two metrics to investigate the ozone exposure for crops in Punjab and Haryana derive south Asia specific exposure yield relationships for wheat and rice. The mean daytime surface ozone (M7) and accumulated exposure over a threshold of 40 nmol mol-1 (AOT40)."

Retained lines 16-20

Shifted P2361 line 20 to P2362 line 2

Retained P2362 line 2-5 "AOT40 is defined….

Shifted P2362 line 6 to P2363 line 9 to the introduction and revised the text (see above)

Revised P2363 line 9-14 "Out of these two parameters, M7 gives equal importance […] while AOT40 gives […]. Hence the former will perform better while evaluating plant damage …

Shifted and revised P2363 line 15 to 18

Reviewer's comment:

as is also the description of cropping seasons and crops where not only the crops used in the investigation but many others are also described. However, a simple percentage of coverage and thus a reason for choosing these particular crops is not given.

Authors' response: We have removed text about those crops not covered in this study as specified below

Modifications in the text: f (means one line after; ff means several lines after….)

P2364 L10f however in some districts…
P2364 L13ff Minor rabi crops are potato, rabi maize, sugarcane, rabi pulses and oilseeds (Sharma and Sood, 2003)[…] or seasonal fruits and vegetables (musk melon, water melon, gourds and cucumber).
P2364 L24f Zayad season crops include moong and vegetables (Saroj et al., 2014).
P2364 L26 replaced "maize based" by "maize-wheat" and inserted % values "rice-wheat (>70%)" cotton-wheat (~20%)
P2364 L26f deleted "Sorghum-wheat rotation is popular in the Shivalik mountains."
P2364 L29 Inserted: rice-wheat (~40%) and cotton-wheat (~20%) deleted: rice-mustard and rice-gram rotation is popular in the north
P2365 L2 inserted "Maize is currently not very popular but heavily promoted as an alternative to rice when a deficient monsoon is anticipated."

Reviewer's comment:

The description of the ozone dose exposure relationships is much too short and irritating. It is not clear which calculations are done with new OTC derived functions and which are not. This is partly done in the results sections (e.g. page 2371, parts of chapters 3.2.1 – 3.2.4) where it doesn't belong. It is also not quite clear from which periods the data for the newly derived functions are obtained and of different periods are used which then might need weighting with phenological preconditions. It would be a great help if all this information could be concentrated and re-written.

Authors' response: We thank the reviewer for pointing this out. We have shifted the relevant text from the results on page 2371 to this section and have modified it to be more specific. Since the relationship is derived based on OTC with ozone fumigation and clean air controls it should not require weighting with phenological preconditions.

Modifications in the text:

The revised text now reads:
"We derive specific exposure–yield relationships for Indian wheat and rice cultivars using a two pronged approach.
Firstly, we use our ozone measurements conducted at a suburban site in Punjab and a number of field studies conducted in the region that reported variations in the sowing date of crops (Chahal et al., 2007; Jalota et al., 2008, 2009; Mahajan et al., 2009; Brar et al., 2012; Buttar et al., 2013; Ram et al., 2013) which lead to coincidental change in ozone exposure and one study that reported collocated yield and ozone measurements (Agrawal et al., 2003) to derive an empirical exposure-yield relationship for rice and wheat. The empirical field data supports the need to revise the exposure-yield relationship for Indian cultivars and demonstrates, that for rice optimizing the sowing date can be a suitable strategy to minimize ozone exposure and maximise crop yields.
Secondly, we derive India specific exposure yield relationships by plotting relative yields (RY) and ozone exposure for all OTC studies on Indian cultivars reported in the peer reviewed literature and fitting the data to obtain an exposure yield relationship. (Rai et al., 2007; Rai and Agrawal, 2008; Singh et al., 2009; Rai et al., 2010; Singh and Agrawal, 2010; Sarkar and Agrawal, 2010, 2012) For maize only one OTC study on two Indian cultivars has been conducted and we use the fit of this data to obtain an exposure yield relationship (Singh et al., 2014). We compare these exposure-yield relationships for rice and wheat with RY observed for cultivars commonly grown in Pakistan and

Bangladesh (Wahid et al., 1995b; Maggs et al., 1995; Maggs and Ashmore, 1998; Wahid, 2006; Akhtar et al., 2010a,b; Wahid et al., 2011) to investigate to which extent the results can be extrapolated to entire South Asia. We refrain from including cultivars popular in South East Asia into our study, as they have been reported to show a very different sensitivity to ozone exposure (Sawada and Kohno, 2009) . We provide an upper and lower limit for RY and crop yield losses for a set of 5 different sowing dates for rice and wheat, 3 for cotton and 2 for rabi and kharif maize both using exposure dose–response relationships established in several studies in the West (Table 2) to provide a lower limit and our new India specific functions to provide an upper limit to the possible loss.
We use both the old (Mills et al., 2007) AOT40 based exposure yield function, as well as our revised AOT 40 based relationship to calculate crop production losses and economic cost losses and contrast the two.”

Reviewer's comment:

Results and Discussion

P2377, L1ff: I agree that rainfall can will reduce ozone related precursors but it would obviously be correlated with low radiation also. So the ozone forming potential would be low and the stomata would be less open, reducing uptake and relative yield loss. Can this be confirmed from the data?

Authors' response: The reviewer is possibly correct in pointing out that radiation plays a larger or equal role compared to the wet scavenging of precursors in reducing the ozone mixing ratios.

We are not aware of any observational evidence from South Asia reporting stomata opening/conductance with sufficient time resolution to investigate whether stomata would be less open during rainy/cloudy conditions. It is clear that the ozone is lower (on average by about 20 ppbv) during rain spells and under heavy cloud cover and if stomata closure reduces uptake further this would only enhance the effect. But then, since plants cannot keep the stomata closed perpetually this would also mean that stomata would preferably open during dry spells when the ozone is much higher. If that is true it would make AOT40 (which is usually high during sunny days) a much better proxy for stomatal flux compared to M7 for the kharif season. Unfortunately, all this discussion is speculative. We are not aware of any experimental data that would allow verification.

Reviewer's comment:

It is also a bit frustrating to read and think about the possible mechanistic relationships and then learn that no new exposure relationships exist for cotton and maize. In my opinion, the article should focus on wheat and rice (as implied in the title). The other crops may however complement the analysis in order to judge the relative importance of the new findings.

Authors' response: For maize we have included a revised relationship based on a recent study by Singh et al. 2014, which also indicates that South Asian cultivars are a factor 2 more sensitive, into the final revised manuscript. When it comes to cotton we are equally frustrated. India grows 25% of the world's cotton and the relative yield losses are potentially very high (almost 50%) even with the old Mills et al. 2007 relationship. Yet there is no data to verify or derive a revised relationship. We, therefore, prefer to retain the discussion of cotton. Removing it would send the wrong signal and would imply losses are not worth discussing, when in fact they are higher than those for rice.

Modifications in the text:

Adding the new relationship for maize has resulted in the following changes:
Table 2 (additional equation), Table 5 (AOT40 based yields in the "this study column") and Table 6 (crop production losses and economic cost losses) as well as an additional column in the table with the results for maize, which has been shifted for the supplement back into the manuscript.
While calculating this revised relationship, we found a mistake in the excel spread sheath. Accidentally the RY for maize had been calculated with the equation for rice. We have corrected this and now RY are higher and RYL are lower. We have checked all spread sheaths and now the correct equations have been used everywhere.
The Abstract has been modified to: "… and established a new crop yield exposure relationship for South Asian wheat, rice and maize cultivars…"

Section 3.2.4 was revised as follows:" Maize is planted both as Rabi and Kharif crop, however, cultivation occurs only on a~limited area, but maize is heavily promoted as an alternative to rice when a deficient monsoon is anticipated. We could not find any study reporting crop yields for maize planted in Punjab or Haryana in the peer reviewed literature. A recent study investigating ozone related crop yield losses for Indian maize cultivars (Singh et al., 2014), found Indian maize cultivars are twice as sensitive to ozone compared to their American and European counterparts. However, maize is one order of magnitude less sensitive to ozone compared to rice and wheat and is, therefore, a suitable alternative for drought years. We use all three ozone exposure RY
relationships (Heck et al., 1984b; Mills et al., 2007; Singh et al., 2014) to calculate relative yields
(Table~8) and find that in the real world both the differences between the revised and old relationship and the overall losses are minor."

Reviewer's comment:
What I feel is missing is an analysis about the relative sensitivity of the results to 1)
weather conditions in different years and the determination of ozone concentrations for
the region and seasons, and 2) the exposure – damage functions used. To which degree can damage be avoided if sowing dates are adapted?
Is it necessary to include a seasonal dynamic sensitivity to judge this and in which way would a cumulative uptake calculation be beneficial to the analysis?

Authors' response: Response to 1) Currently there is too little temporal overlap between the yield data and our ozone and meteorological dataset to attempt a detailed analysis investigating the influence of weather conditions in different years. With only 2 kharif and rabi seasons worth of data for which the yields have been finalized and reported in the statistical yearbook, we do not have a sufficiently large dataset for a comprehensive sensitivity analysis. This can be a topic of a future study. Response to 2) This data, including a cumulative exposure calculation for different sowing dates has been presented in supplementary table 1-4. Since reviewer #3 has shown substantial interest in this information and could not find it in the supplement, we have shifted these tables back into the main text and have added to the discussion the following statement.

Modification in the text
Shifted supplementary table 1-4 back into the main paper and changed the references to these tables.
Moreover, we added the following text to the discussion P2372 L5: "For rice late sowing (1st of June) and late transplantation (1st of July) leads to the lowest relative yield losses (18%) while early sowing (1st April) and transplantation (1st May) doubles ozone related yield losses (35%)."

Reviewer's comment:
Conclusion
P2383, L10ff: The polical demands seem to be quite unrelated to the research presented here. Despite they might generally be valid I don't think they should be voiced here.
Authors' response:
Removed P2383, L10ff
Reviewer's comment:
Others
Despite an overall understandable stile, there are some problems with spelling and grammar as well as referring to the correct equation number (p.2366), full description of equation variables and other abbreviations (IGP). The text should also be checked for repetitions (e.g. p2370) and caption descriptions which belong beneath the figures (e.g. p.2371, 2374) that give some room for shortenings.
Authors' response:
We have corrected the equation number and the abbreviations and removed the repetition on . p2370 and have shifted part of the text to the figure caption as detailed below:

Shifted to figure caption Page 2371 Line 28-Page 2372 Line 3: "Ozone exposure for rice sowed on different sowing dates has been calculated using our data Table~5 Yield data for rice has been taken from the peer reviewed literature (Chahal et al, 2007; Jalota et al., 2009; Mahajan et al. 2009; Brar et al., 20120)."

Removed text that was already present in the figure caption Page 2372 Line 9-12 "Large diamonds indicate studies on Basmati, all other studies were conducted on paddy. Circles show plant chamber studies on Bangladeshi rice cultivars conducted in Japan and the dashed line delineates the European (AOT40, (Mills et al., 2007) and American (M7, (Adams et al. 1989) dose response relationship."

Shifted to the figure caption Page 2374 Line 3-12 "Ozone exposure for wheat sowed on different sowing dates has been calculated using our data (Table~6). Yield data for wheat have been taken from the peer reviewed literature (Agrawal et al., 2003; Chahal et al., 2007; Jalota et al., 2008; Coventry et al., 2011; Buttar et al., 2013; Ram et al., 2013). Agrawal et al. (2003) reported co-located measurements of ozone exposure and yields for a~number of urban locations that included residential areas and kerb site locations, where NO titration leads to low wintertime ozone levels. Other studies reported yields corresponding to different sowing date. The yield data has been positioned in conformation to the emergence dates (Period 1 to 5) defined in Supplement S1."

Removed text that was already present in the figure caption page 2374L23, "Circles show plant chamber studies on Bangladeshi wheat cultivars conducted in Japan"

Reviewer's comment:
Figures and Tables
I a bit irritated by seeing cumulative exposure indices per month. I thought that the cumulative index always refers to the period of a plants (leaves) exposure to ozone. If any, the index should be steadily increasing until harvest. Could you thus please explain what the relevance or meaning of the values presented in Table 2?
Authors' response:
We have given the cumulative index month wise, to provide data that can be of use to a variety of Authors'. We now call it "Monthly values of M7 and increment in AOT40 in the respective month" in the figure caption and have modified the text to "Table 3 shows the monthly increment in AOT40 and the monthly M7…" to avoid confusion. The purpose of giving the information in this format is twofold.
The region is notorious for its diversity; it is not uncommon to see that on one field the farmer is still burning the crop residue of the previous crop, while on the neighbouring field the flag leaves of the wheat crop sown more than a month ago are already several cm tall. Similarly, some farmers sow early and try to transplant their rice in May or early June in the hope of squeezing another crop in between rice and wheat while others will sow in June and transplant early in July. Month wise data will allow the interested user to sum up himself/herself, for the relevant growth period of their crop and can be useful for agricultural scientists in the region.
Moreover, this data can also be used for model validation. The winter growing season for example includes both persistent winter fog in December and January as well as heat waves with temperatures in the upper 30s later during the grain filling stage. Month wise indices allow a more detailed evaluation of model performance. Models could predict the right cumulative exposure for the whole growing season for the wrong reasons (e.g. if both the extreme fog episodes and the heat waves in March are not well captured).

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